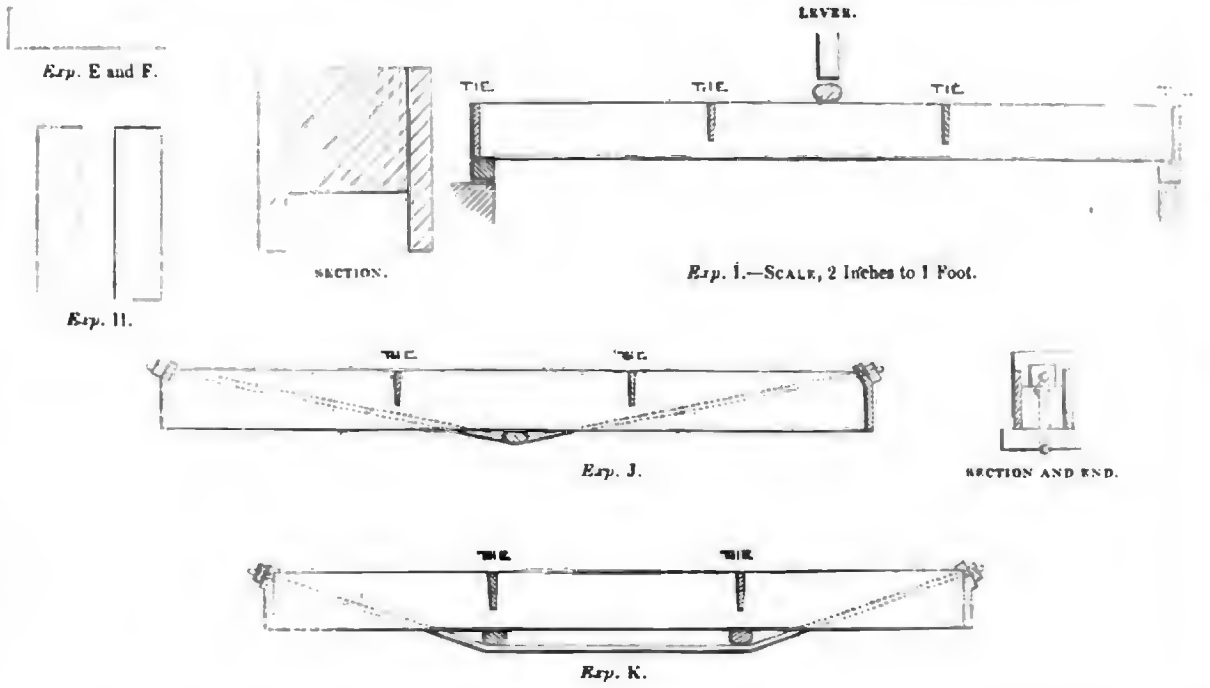
EXPERIMENTS ON THE FORM OF CAST-IRON GIRDERS.



EXPERIMENTS ON THE FORM OF CAST-IRON GIRDERS.*

We continue the record of important experiments on the relative value of different forms of cast-iron beams, with Mr. G. Cooper's own observations upon them.

Experiments E and F demonstrate the values of doubling, and trebling the quantities of experiment A; but they are weighted reversely, viz., on the minor instead of the major depth—experiment E being similar to experiment B reversed; bearing about 25 per cent. only of the same. Experiment F, also similar to experiment C, bearing about 40 per cent. of it: the deflection being excessive, averaging from one-third to one-half of their respective depths. Thus, for any available purpose, they exclude themselves; but, in connection with the vertical web, we revert to experiment D, and it is then the accumulated material is of value. Experiment H is a continuation of experiment C, with the quantities doubled: the strength in comparison therewith is decreased and the stiffness increased, and the same observations obviously apply wholly to this experiment as to experiment C, shewing it to be a section to be received with caution, and to be used only when a connection can be made of each with the other, as more clearly seen by the following experiment I, and then not of the double breadth; the positive strength of this great addition of material, in comparison with four times experiment A, being only as 3·8 to 2·64.

Experiment I is a new experiment, inasmuch as a combination of two is made of experiment A, the two being made into one box-beam by transverse ties, the whole depth, at each end; and two intermediate ditto of three-fourths the depth. Excluding the weight of the ties, the average weight of the several beams experimented upon will not exceed the double of those of experiment A. The main advantage, it will be perceived, gained by this connection, consists of increased stiffness, and not strength, the strength being no advance upon either experiments B or C, as, when the weight of the ties is deducted, identity appears to exist with them. In looking at the simple forms, now briefly rehearsed, and interestingly made more evident by studying the accompanying papers lettered according to the preceding remarks, it will be observed that a near equality of deflection in the whole exists according to the equal weights even to the breaking points, and that in the whole of them no indication of failure is given by the beam previous to the instant of actual rupture.

Passing now to the consideration of the application of the wrought tension-rod to cast-iron beams, as a means of deriving therefrom an increase of strength, it has been the object, in these experiments, to apply it in the cheapest, readiest, and most simple way; and the box-beam experiments I, being that which presented the greatest facilities, as well as having already produced a result positive to itself and comparative with experiments A, it was thereto applied in the four different ways, as shewn in the various experiments lettered J, K, L, M.

The results of the first two experiments marked J and K, are so perfectly identical that they may be taken as one;—first proving, that, whether the beam be trussed from one or from two bearing points, neither is any advantage gained by the one, nor does any diminution of strength appertain to the other. The real value of the breaking weight appears more than that of the beam untrussed (experiment I), but, upon looking at experiments J and K, Nos. 8* and 11, it is there seen that the ratio is raised by these two experiments, the one, No. 8*, shewing a reason for such a strength by an increase of weight of ten to eleven ounces, or one-twelfth of its own weight; in the other, No. 11, the cause not being so apparent. Excluding the weight of the bolt and bearing saddles, there appears to be wanting entirely the useful strength of the bolt. No benefit arises therefrom, excepting when fracture has occurred in the beam; for when the load has been regularly and progressingly laid on, and not suffered to fall at fracturing, the bolt sustains the two halves of the fractured beam from falling. This was invariably the case, saving when, at the points of failure, the load was suffered to fall with the broken beam one-and-a-half to twice the depth of the beam; in which instances the bolt gave way at the nut, that being the weakest part, the thread being *cut out* of its substance. When the load was suffered to descend with the beam at fracturing, a distance of one-half the depth of the beam, the bolt itself remained entire. It would appear from the deflection of the beam remaining so perfectly identical with the untrussed beams (experiments I), that no stiffness, or indeed any action, arises from the bolt in connection with the beam, it remaining inert, or at most yielding to the weight with as much readiness as the weight is applied, being inferior in tenacity to the material to which it is added, yet to similar weights yielding a greater deflection,—leaving the load the more, the more it is accumulated. The diameter of the wrought-iron tension-rod used in these experiments was ·25 inches, and, if brought into proper action, ought to have added at least two-thirds to the breaking weights. As before observed, the diminished deflection both of these and the untrussed beams (experiment I), over the loose beams (experiment C), appears to arise only from their being tied into one casting; the one being 350, the other about 400, or about one-thirteenth to one-fifteenth or one-sixteenth of their depth. The beams experimented upon under the letters J and K were trussed by the bolt, within the line of compression, or a horizontal line drawn through the centres of the two nuts which confined its ends, would fall within the body of the beam; and such metal above and in a line with it, if the bolt were useful, as supposed, would be to it as a thrust or compression piece, until the deflection of the beam under its load brought such upper edge below the centre of the bolt, which, in experiments J and K, was not the case, the deflection being but ·129 inches.

* See p. 588, ante.

E and F.—Transverse Strain on a simple Rectangular Cast-iron Beam, weighted horizontally. All else relating to it, similar to last.

E.—Double Width of A.		F.—Treble Width of A.	
No. 18 Experiment. Weight of Beam, 113 oz.		No. 17 Experiment. Weight of Beam, 196½ oz.	
Pressure in lbs.	Deflection in lbs.	Pressure in lbs.	Deflection in lbs.
220	·172	220	
289	·222	820	·193
352	·267	988	·238
412	·307	1072	·260
472	·356	1156	·282
532	·433	1240	·312
592	·483	1279	·324
655	·560-565	1324	·338
709	·620	1363	·354
757	·670*	1399	·364
		1405	·378
		1444	·391
		1483	·442*

Breaks at the edge of the centre bearing-piece; and generally this applies to the whole of these experiments to H inclusive.

This beam was weighed in the precise position in which it was cast. The lower face, being cast in the same position as very sound castings, although the whole of the upper surface, or skin, appeared unsound or honeycombed.

* Broke.